PUBLIC HEALTH

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SUMMARY OF CONCLUSIONS

Staff has analyzed potential public health risks associated with construction and operation of Humboldt Bay Repowering Project (HBRP). Given the information provided by the project applicant on the emission factors for the toxic air contaminants that would be emitted from the ten Wärtsilä engines when burning diesel fuel and using EPA-approved modeling, staff has found that the risk of cancer would be 29.1 in a million. This is considerably above the level of significance (10 excess cancers in one million with the use of Toxics-Best Available Control Technology -- T-BACT) used by staff in all power plant siting cases. In the numerous other in-state power plant proposals reviewed by staff, staff has not seen cancer risks above this level of significance. The applicant has estimated the cancer risk to be 10.7 in one million which would also be above the level of significance considering the same scenario as analyzed by staff. Staff also concludes that no acute (short-term) or chronic (long-term) non-cancer health impacts would be expected to occur to any members of the public including low income and minority populations.

Staff believes that there are several options that the applicant should pursue to reduce the risk to the public to below the level of significance. They are:

1. Reduce diesel particulate emissions from the stacks with post-combustion controls such as diesel particulate filters or catalysts;

2. Use alternative fuels such as compressed natural gas stored on-site, or compressed or liquefied natural gas or propane stored at another location; or

3. Use alternative technologies such as combustion turbines that could change flue gas parameters to reduce modeled impacts.

INTRODUCTION

The purpose of this Preliminary Staff Assessment (PSA) is to determine if toxic emissions from the proposed HBRP would have the potential to cause significant adverse public health impacts or violate standards for public health protection. If potentially significant health impacts are identified, staff evaluates mitigation measures that could reduce such impacts to less than significant levels.

Although staff addresses potential impacts of regulated or criteria air pollutants in the **Air Quality** section of this PSA, **Public Health Appendix A** at the end of this section provides information on the health effects of such pollutants. Impacts on public and worker health from accidental releases of hazardous materials are examined in the **Hazardous Materials Management** section. Health effects from electromagnetic fields are discussed in the **Transmission Line Safety and Nuisance** section. Pollutants released from the project in wastewater streams to the public sewer system are discussed in the **Soil and Water Resources** section. Plant releases in the form of hazardous and nonhazardous wastes are described in the **Waste Management** section.

LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

PUBLIC HEALTH Table 1
Laws, Ordinances, Regulations, and Standards (LORS)

Applicable Law	Description
Federal	
Clean Air Act section 112 (42 U.S. Code section 7412)	Requires new sources which emit more than ten tons per year of any specified hazardous air pollutant (HAP) or more than 25 tons per year of any combination of HAPs to apply Maximum Achievable Control Technology (MACT).
State	
California Health and Safety Code section 41700	This section states that "no person shall discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health, or safety of any such persons or the public, or which cause, or have a natural tendency to cause injury or damage to business or property."
CA Health & Safety Code §40001	Prohibits emissions and other discharges (such as smoke and odors) from specific sources of air pollution in excess of specified levels.
CARB Air Toxics Control Measure (ATCM) for Compression Ignition Nonroad Engines PRC Title 17 section 93115	Regulates potential cancer risk and noncarcinogenic chronic health hazards of compression ignition nonroad engines.
Health and Safety Code 25249.5 et seq	These regulations implement Proposition 65, the statue that requires that notice be given to the public if exposure to chemicals known to cause cancer or reproductive toxicity exceed threshold levels.
Health and Safety Code Sections 44360 to 4366 (Air Toxics "Hot Spots" Information and Assessment Act—AB 2588)	Requires the preparation of a human health risk assessment that addresses public exposure to toxic air contaminants emitted from stationary sources and requires notification to the public and risk reduction measures identified by the local air district.
Local	none

SETTING

This section describes the environment in the vicinity of the proposed project site from the public health perspective. Features of the natural environment, such as meteorology and terrain, affect the project's potential for causing impacts on public health. An emissions plume from a facility may affect elevated areas before lower terrain areas, due to a reduced opportunity for atmospheric mixing. Consequently, areas of elevated terrain can often be subjected to increased pollutant impacts. Also, the types of land use near a site influence the surrounding population distribution and density, which, in turn, affects public exposure to project emissions. Additional factors affecting potential public health impacts include existing air quality and environmental site contamination. Surrounding land uses to the HBRP include rural residential, port-related industrial, agricultural, and recreational uses (PG&E 2006a, Section 1.1).

SITE AND VICINITY DESCRIPTION

The 5.4-acre Humboldt Bay Repowering Project (HBRP) site is within 143 acres owned by Pacific Gas and Electric Company (PG&E), in the unincorporated area of Humboldt County. The proposed HBRP site is situated on property that houses the existing Humboldt Bay Power Plant. The site is located on Buhne Point, which is a small peninsula along Humboldt Bay. The City of Eureka is 3 miles north of the HBRP site and is the largest city in Humboldt County. There are several small residential communities within 5 miles of the HBRP site, including King Salmon, Humboldt Hill, and Fields Landing.

There are two sensitive receptors within a 1-mile radius of the HBRP: (1) South Bay Elementary School, 6077 Loma Avenue, Eureka, and (2) a senior home, Sun Bridge Seaview Care Center, 6400 Purdue Drive, Eureka, both southeast of the project site. Two churches are within 1-mile northeast and south of the project site. These are the Redwood Christian Center, 6000 Humboldt Hill Road, Eureka, and the Calvary Community Church, 510 South Bay Depot Road, Fields Landing. A summary of sensitive receptors within a 6-mile radius may be found in Appendix 8.9A of the AFC.

The terrain in the vicinity of the Humboldt Bay Power Plant rises rapidly from the bay on the north side to an elevation of approximately 69 feet mean lower low water (MLLW) at Buhne Point peninsula. Terrain to the north and east of the site is generally flat. To the south and east, the terrain rises rapidly, forming Humboldt Hill, which reaches an elevation of over 500 feet within 2 miles of the project and is the site of several small neighborhoods. Humboldt County is mostly mountainous except for the level plain that surrounds Humboldt Bay. The coastal hills surrounding Humboldt Bay greatly modify the rainfall and temperatures of the region by creating a rain shadow and sheltering the region from the brunt of the heavier rainfall and temperature extremes (PG&E 2006a, Section 8.1.1.1).

CLIMATE AND METEOROLOGY

Meteorological conditions, including wind speed, wind direction, and atmospheric stability, affect the extent to which pollutants are dispersed into ambient air as well as the direction of pollutant transport. This, in turn, affects the level of public exposure to emitted pollutants and associated health risks. When wind speeds are low and the atmosphere is stable, for example, dispersion is reduced and localized exposure may be increased.

The overall climate at the project site is dominated by the semi-permanent eastern Pacific high pressure system centered off the coast of California. In the summer, the high pressure system moves to its northernmost position, which results in strong northwesterly flows and light precipitation. In the winter, the high pressure system moves southwestward toward Hawaii, which allows storms originating in the Gulf of Alaska to reach northern California, bringing wind and rain. As winter storms move in from the Pacific and Gulf of Alaska, the prefrontal winds are generally from the southeast to southwest. Over the Humboldt Bay area, the hills generally deflect these winds south to southeast. After frontal passage, the winds are generally from the north to northwest. During the rainy season, generally November through March, Eureka receives 75% of its average rainfall, with most of the rain falling during December and January. The average annual rainfall over the 100-year period of record is 38.87 inches. This is one of the lowest averages in northwest California and is caused by a rain shadow due to the surrounding hills and minimal uplifting along the immediate west-facing beaches. Colder, more stagnant conditions during this time of the year are conducive to the buildup of particulate matter (PM), including the formation of secondary ammonium nitrate. In addition, increased emissions from residential fireplaces and wood stoves during this time of year contribute to increased direct particulate emissions (PG&E 2006a, Section 8.1.1.2). Staff's **Air Quality** section presents more detailed meteorological data.

EXISTING AIR QUALITY

The proposed site is within the jurisdiction of the North Coast Unified Air Quality Management District (NCUAQMD). By examining average toxic concentration levels from representative air monitoring sites in the project vicinity with cancer risk factors specific to each contaminant, lifetime cancer risk can be calculated to provide a background risk level for inhalation of ambient air. For comparison purposes, it should be noted that the overall lifetime cancer risk for the average individual in the United States is about 1 in 4, or 250,000 in one million.

The use of reformulated gasoline, beginning in the second quarter of 1996, as well as other toxics reduction measures, have led to a decrease of ambient levels of toxics and associated cancer risk in the state during the past few years.

ASSESSMENT OF IMPACTS AND DISCUSSION OF MITIGATION

METHOD AND THRESHOLD FOR DETERMINING SIGNIFICANCE

The Public Health section of this staff assessment discusses toxic emissions to which the public could be exposed during project construction and operation. Following the release of toxic contaminants into the air or water, people may come into contact with them through inhalation, dermal contact, or ingestion via contaminated food or water.

Air pollutants for which no ambient air quality standards have been established are called noncriteria pollutants. Unlike criteria pollutants such as ozone, carbon monoxide, sulfur dioxide, or nitrogen dioxide, noncriteria pollutants have no ambient (outdoor) air quality standards that specify levels considered safe for everyone. Since noncriteria pollutants do not have such standards, a health risk assessment is used to determine if people might be exposed to those types of pollutants at unhealthy levels. The risk assessment consists of the following steps:

- Identify the types and amounts of hazardous substances that HBRP could emit to the environment;
- Estimate worst-case concentrations of project emissions in the environment using US EPA approved air dispersion modeling;
- Estimate amounts of pollutants that people could be exposed to through inhalation, ingestion, and dermal contact; and
- Characterize potential health risks by comparing worst-case exposure to safe standards based on known health effects.

Staff relies upon the expertise of Cal-EPA Office of Environmental Health Hazard Assessment (OEHHA) to identify contaminants that are known to the state to cause cancer or other noncancer toxicological endpoints and to calculate the toxicity and cancer potency factors of these contaminants. Staff also relies upon the expertise of the California Air Resources Board and the local air districts to conduct ambient air monitoring of toxic air contaminants and the California Department of Public Health to conduct epidemiological investigations into the impacts of pollutants on communities. It is not within the purview or the expertise of the Energy Commission staff to duplicate the expertise and statutory responsibility of these agencies.

Initially, a screening level risk assessment is performed using simplified assumptions that are intentionally biased toward protection of public health. That is, an analysis is designed that overestimates public health impacts from exposure to project emissions. In reality, it is likely that the actual risks from the power plant will be much lower than the risks as estimated by the screening level assessment. The risks for screening purposes are based on examining conditions that would lead to the highest, or worst-case risks, and then using those conditions in the study. Such conditions include:

- Using the highest levels of pollutants that could be emitted from the plant;
- Assuming weather conditions that would lead to the maximum ambient concentration of pollutants;
- Using the type of air quality computer model that predicts the greatest plausible impacts;
- Calculating health risks at the location where the pollutant concentrations are estimated to be the highest;
- Assuming that an individual's exposure to cancer-causing agents occurs continuously for 70 years; and
- Using health-based standards designed to protect the most sensitive members of the population (i.e., the young, elderly, and those with respiratory illnesses).

A screening level risk assessment will, at a minimum, include the potential health effects from inhaling hazardous substances. Some facilities may also emit certain substances that could present a health hazard from noninhalation pathways of exposure (OEHHA 2003, Tables 5.1, 6.3, 7.1). When these substances are present in facility emissions, the screening level analysis includes the following additional exposure pathways: soil ingestion, dermal exposure, and mother's milk (OEHHA 2003, p. 5-3).

The standard risk assessment process addresses three categories of health impacts: acute (short-term) health effects, chronic (long-term) noncancer health effects, and cancer risk (also long-term). Acute health effects result from short-term (one-hour) exposure to relatively high concentrations of pollutants. Acute effects are temporary in nature and include symptoms such as irritation of the eyes, skin, and respiratory tract.

Chronic health effects are those that arise as a result of long-term exposure to lower concentrations of pollutants. The exposure period is considered to be approximately from twelve to one hundred percent of a lifetime, or from eight to seventy years (OEHHA 2003, p. 6-5). Chronic health effects include diseases such as reduced lung function and heart disease.

The analysis for noncancer health effects compares the maximum project contaminant levels to safe levels called "reference exposure levels" or RELs. These are amounts of toxic substances to which even sensitive people can be exposed and suffer no adverse health effects (OEHHA 2003, p. 6-2). These exposure levels are designed to protect the most sensitive individuals in the population such as infants, the aged, and people suffering from illness or disease that makes them more sensitive to the effects of toxic substance exposure. The RELs are based on the most sensitive adverse health effect reported in the medical and toxicological literature and include margins of safety. The margin of safety addresses uncertainties associated with inconclusive scientific and technical information available at the time of standard setting and is meant to provide a reasonable degree of protection against hazards that research has not yet identified. The margin of safety is designed to prevent pollution levels that have been demonstrated to be harmful, as well as to prevent lower pollutant levels that may pose an unacceptable risk of harm, even if the risk is not precisely identified as to nature or degree. Health protection is achieved if the estimated worst-case exposure is below the REL. In such a case, an adequate margin of safety exists between the predicted exposure and the estimated threshold dose for toxicity.

Exposure to multiple toxic substances may result in health effects that are equal to, less than, or greater than effects resulting from exposure to the individual chemicals. Only a small fraction of the thousands of potential combinations of chemicals have been tested for the health effects of combined exposures. In conformity with the California Air Pollution Control Officers Association (CAPCOA) guidelines, the health risk assessment assumes that the effects of each substance are additive for a given organ system (OEHHA 2003, pp. 1-5, 8-12). Other possible mechanisms due to multiple exposures include those cases where the actions may be synergistic or antagonistic (where the effects are greater or less than the sum, respectively). For these types of substances, the health risk assessment could underestimate or overestimate the risks.

For carcinogenic substances, the health assessment considers the risk of developing cancer and assumes that continuous exposure to the cancer-causing substance occurs over a 70-year lifetime. The risk that is calculated is not meant to project the actual expected incidence of cancer, but rather a theoretical upper-bound number based on worst-case assumptions. Cancer risk is expressed in chances per million, and is a function of the maximum expected pollutant concentration, the probability that a particular pollutant will cause cancer (called “potency factors”, and established by the California Office of Environmental Health Hazard Assessment - OEHHA), and the length of the exposure period. Cancer risks for each carcinogen are added to yield total cancer risk. The conservative nature of the screening assumptions used means that actual cancer risks due to project emissions are likely to be considerably lower than those estimated.

The screening analysis is performed to assess worst-case risks to public health associated with the proposed project. If the screening analysis predicts no significant risks, then no further analysis is required. However, if risks are above the significance level, then further analysis, using more realistic site-specific assumptions would be performed to obtain a more accurate assessment of potential public health risks.

Significance Criteria

Commission staff determines the health effects of exposure to toxic emissions based on impacts to the maximum exposed individual. This is a person hypothetically exposed to project emissions at a location where the highest ambient impacts were calculated using worst-case assumptions, as described above.

As described earlier, non-criteria pollutants are evaluated for short-term (acute) and long-term (chronic) noncancer health effects, as well as cancer (long-term) health effects. The significance of project health impacts is determined separately for each of the three categories.

Acute and Chronic Noncancer Health Effects

Staff assesses the significance of non-cancer health effects by calculating a “hazard index.” A hazard index is a ratio comparing exposure from facility emissions to the reference (safe) exposure level. A ratio of less than one signifies that the worst-case exposure is below the safe level. The hazard index for every toxic substance that has the same type of health effect is added to yield a total hazard index. The total hazard index is calculated separately for acute and chronic effects. A total hazard index of less than one indicates that cumulative worst-case exposures are less than the reference exposure levels. Under these conditions, health protection from the project is likely to be achieved, even for sensitive members of the population. In such a case, staff presumes that there would be no significant non-cancer project-related public health impacts.

Cancer Risk

Staff relies upon regulations implementing the provisions of Proposition 65, the Safe Drinking Water and Toxic Enforcement Act of 1986 (Health & Safety Code, §§ 25249.5 et seq.) for guidance to determine a cancer risk significance level. Title 22, California Code of Regulations, section 12703(b) states that “the risk level which represents no significant risk shall be one which is calculated to result in one excess case of cancer in an exposed population of 100,000, assuming lifetime exposure." This level of risk is equivalent to a cancer risk of ten in one million, or $10x10^{-6}$. An important distinction is that the Proposition 65 significance level applies separately to each cancer-causing substance, whereas staff determines significance based on the total risk from all cancer-causing chemicals. Thus, the manner in which the significance level is applied by staff is more conservative (health-protective) than that which applies to Proposition 65.

The significant risk level of ten in one million is consistent with the level of significance adopted by several Air Quality Management Districts (AQMD) in the state, including the two largest, the Bay Area AQMD and the South Coast AQMD. The North Coast Unified Air Quality Management District has not adopted a toxic air contaminant regulation, but in general, the Bay Area AQMD, the South Coast AQMD, and most other air districts in the state would not approve a project with a cancer risk exceeding ten in one million and thus it is doubtful that the NCUAQMD would approve such a project even without an adopted standard.

Staff's analysis also addresses potential impacts on all members of the population including the young, the elderly, people with existing medical conditions that may make them more sensitive to the adverse effects of toxic air contaminants and any minority or low income populations that are likely to be disproportionately affected by impacts (because these populations often have a greater incidence of pre-existing medical conditions). In order to accomplish this goal, staff utilizes the most current acceptable public health exposure levels (both acute and chronic) set by OEHHA or U.S. EPA to protect the public from the effects of airborne toxics. When a screening analysis shows cancer risks to be above the significance level, refined assumptions would likely result in a lower, more realistic risk estimate. If facility risk, based on refined assumptions, exceeds the significance level of ten in one million, staff would require appropriate measures to reduce the risk to less than significant. If, after all risk reduction measures had been considered, a refined analysis identifies a cancer risk greater than ten in one million, staff would deem such risk to be significant and would not recommend approval of the project as proposed.

DIRECT/INDIRECT IMPACTS AND MITIGATION

CONSTRUCTION IMPACTS AND MITIGATION

Potential risks to public health during construction may be associated with exposure to toxic substances in contaminated soil disturbed during site preparation, as well as diesel exhaust from heavy equipment operation. Criteria pollutant impacts from the operation of heavy equipment and particulate matter from earth moving are examined in staff's **Air Quality** analysis.

Site disturbances occur during facility construction from excavation, grading, and earth moving. Such activities have the potential to adversely affect public health through various mechanisms, such as the creation of airborne dust, material being carried off-site through soil erosion, and uncovering buried hazardous substances.

The operation of construction equipment will result in air emissions from diesel-fueled engines. Although diesel exhaust contains criteria pollutants such as nitrogen oxides, carbon monoxide, and sulfur oxides, it also includes a complex mixture of thousands of gases and fine particles. These particles are primarily composed of aggregates of spherical carbon particles coated with organic and inorganic substances. Diesel exhaust contains over 40 substances that are listed by the U.S. Environmental Protection Agency (U.S. EPA) as hazardous air pollutants and by CARB as toxic air contaminants.

Exposure to diesel exhaust may cause both short- and long-term adverse health effects. Short-term effects can include increased cough, labored breathing, chest tightness, wheezing, and eye and nasal irritation. Long-term effects can include increased coughing, chronic bronchitis, reductions in lung function, and inflammation of the lung. Epidemiological studies also strongly suggest a causal relationship between occupational diesel exhaust exposure and lung cancer.

Based on a number of health effects studies, the Scientific Review Panel (SRP) on Toxic Air Contaminants recommended a chronic REL (see REL discussion in Method of Analysis section above) for diesel exhaust particulate matter of 5 $\mu g/m^3$ and a cancer unit risk factor of $3x10^{-4}$ $(\mu g/m^3)^{-1}$ (SRP 1998, p. 6). The SRP, established pursuant to California Health and Safety Code section 39670, evaluates the risk assessments of substances proposed for identification as Toxic Air Contaminants by CARB and the Department of Pesticide Regulation (DPR). The SRP reviews the exposure and health assessment reports and the underlying scientific data upon which the reports are based.] The SRP did not recommend a value for an acute REL, since available data in support of a value was deemed insufficient. On August 27, 1998, CARB listed particulate emissions from diesel-fueled engines as a toxic air contaminant and approved SRP's recommendations regarding health effect levels.

The initial construction of the HBRP is expected to last approximately 21 months, including 1 month of road construction, 2 months of site clearing and 18 months of project construction. As noted earlier, assessment of chronic (long-term) health effects assumes continuous exposure to toxic substances over a significantly longer time period, typically from eight to seventy years.

Emissions due to the construction phase of the project have been estimated, including an assessment of emissions from vehicle and equipment exhaust and the fugitive dust generated from material handling. A dispersion modeling analysis was conducted based on these emissions. A detailed analysis of the emissions and ambient impacts is included in the **Air Quality** section of this PSA.

Impacts from exposure to diesel particulate matter (DPM) generated during project construction have also been evaluated. The carcinogenic risk due to exposure to DPM during construction activities is expected to be between approximately 5 and 8 in 1 million. These risk estimates are less than the significance level of 10 in 1 million. The area in which the risk may exceed 1 in 1 million (DPM impact greater than or equal to approximately 0.1 µg/m3) extends only about 700 meters beyond the facility fenceline and does not include any residences (PG&E 2006a, Section 8.1.2.10).

The applicant estimated worst-case hourly dust emissions of 3.8 lb/day of particulate matter less than 10 microns (PM10) and .8 lb/day of particulate matter less than 2.5 microns (PM2.5). Diesel emissions are generated from sources such as trucks, graders, cranes, welding machines, electric generators, air compressors, and water pumps. Staff's modeling of construction activities including impacts of fugitive dust over a 12 month period resulted in a predicted annual average concentration of 3 $\mu g/m^3$ of PM10 and ~1.0 $\mu g/m^3$ PM2.5 at any location (see staff **Air Quality** section of this PSA). Mitigation measures are proposed by both the applicant and Air Quality staff to reduce the maximum calculated PM10 as well as PM2.5 concentrations. These include the use of extensive fugitive dust control measures. The fugitive dust control measures are assumed to result in 90% reductions of emissions.

In order to mitigate potential impacts from particulate emissions during the operation of diesel-powered construction equipment, Air Quality staff recommends Tier 2 California Emission Standards for Off-Road Compression-Ignition Engines or the installation of an oxidation catalyst and soot filters on diesel equipment. The catalyzed diesel particulate filters are passive, self-regenerating filters that reduce particulate matter, carbon monoxide, and hydrocarbon emissions through catalytic oxidation and filtration. The degree of particulate matter reduction is comparable for both mitigation measures in the range of approximately 85-92%. Such filters would reduce diesel emissions during construction and reduce any potential for significant health impacts. (See Condition of Certification AQ-SC5 for staff's proposal to control particulate matter.)

OPERATION IMPACTS AND MITIGATION

Emissions Sources

The emissions sources at the proposed HBRP site include ten (10) reciprocating internal combustion engines, an emergency diesel generator, and a diesel fire pump engine.

As noted earlier, the first step in a health risk assessment is to identify potentially toxic compounds that may be emitted from the facility.

Table 8.1A-8 of the AFC lists non-criteria pollutants that may be emitted from the HBRP turbines as combustion byproducts, along with their anticipated amounts (emission factors). Table 8.1A-4 lists emission rates from emergency diesel generator emissions. Table 8.1A-5 lists emission rates from diesel fire pump engine emissions. Emission factors are from the California Air Toxics Emission Factors (CATEF II) database (CARB 2001). Table 8.9-3 of the AFC lists toxicity values used to characterize cancer and noncancer health impacts from project pollutants. The toxicity values include RELs, which are used to calculate short-term and long-term noncancer health effects, and cancer unit risks, which are used to calculate the lifetime risk of developing cancer, as published in the OEHHA Guidelines (OEHHA 2003). **Public Health Table 2** lists toxic emissions and shows how each contributes to the health risk assessment. For example, the first row shows that oral exposure to acetaldehyde is not of concern, but if inhaled, may have cancer and chronic (long-term) noncancer health effects, but not acute (short-term) effects.

Emissions Levels

Once potential emissions are identified, the next step is to quantify them by conducting a “worst case” analysis. Maximum hourly emissions are required to calculate acute (one-hour) noncancer health effects, while estimates of maximum emissions on an annual basis are required to calculate cancer and chronic (long-term) noncancer health effects.

The initial filing of the proposed project (PG&E 2006a) specified 100-percent diesel firing for 100 hours per year per engine for the Health Risk Analysis, and 800 hours per year per engine for the federal Prevention of Significant Deterioration (PSD) permit analysis. However, the inconsistency between the two limits, and errors in some of the underlying modeling assumptions and analyses required that the project be reconfigured and the modeling assumptions and impacts be reworked. The applicant refiled the modeling and air and public health analyses on September 28, 2007 (CH2MHILL 2007h) with some new assumptions:

- a upper limit of 50 hours of 100-percent diesel firing per year per engine, for testing and maintenance only;
- unlimited hours 100-percent diesel firing for “emergencies,” although the emissions and impacts were not analyzed;
- 100-foot stack heights; and
- reduced particulate matter emissions levels, based on an assumed level of particulate emissions control from the oxidation catalyst.

PUBLIC HEALTH Table 2
Types of Health Impacts and Exposure Routes Attributed to Toxic Emissions*

Substance	Oral Cancer	Oral Noncancer	Inhalation Cancer	Noncancer (Chronic)	Noncancer (Acute)
Acetaldehyde			✔	✔	
Acrolein				✔	✔
Ammonia				✔	✔
Arsenic	✔	✔	✔	✔	✔
Benzene			✔	✔	✔
1,3-Butadiene			✔	✔	
Cadmium		✔	✔	✔	
Chromium VI		✔	✔	✔	
Copper				✔	✔
Diesel Exhaust			✔	✔	
Ethylbenzene				✔	
Formaldehyde			✔	✔	✔
Hexane				✔	
Lead	✔		✔		
Mercury		✔		✔	✔

Napthalene		✔	✔	✔	
Nickel		✔	✔	✔	✔
Polynuclear Aromatic Hydrocarbons (PAHs)	✔	✔	✔	✔	
Propylene				✔	
Propylene oxide			✔	✔	✔
Toluene				✔	✔
Xylene				✔	✔
Zinc				✔	

*Source: OEHHA 2003 Appendix L

Subsequent to the applicant's September 2007 filing, the NCUAQMD issued their Preliminary Determination of Compliance (PDOC; NCUAQMD 2007a) incorporating most of the new assumptions, but raised the project limit to 1,000 hours for 100-percent diesel firing per year facility–wide (equivalent to 100 hours per year per engine, but not specific to each engine) for testing, maintenance, and operation. The district requested that the applicant file an updated health risk assessment for the 1,000 hours of 100-percent diesel firing. The applicant filed a revised HRA on November 9, 2007 (SR 2007i). Staff believes that given the detailed discussions by the applicant in the AFC and the October 31, 2007 data responses, the operating limit needed by the applicant for a repowered Humboldt Bay Power Plant includes up to 1,000 hours of 100-percent diesel firing with the remainder of annual operating hours using natural gas with a diesel pilot. The Energy Commission staff provided comments on the PDOC to the NCUAQMD on November 21, 2007. Counter to the applicant's position, staff informed the District that it cannot agree that the project be allowed or permitted for unlimited, unmitigated "emergency" operation while firing 100-percent diesel fuel.

The next step in the health risk assessment process is to estimate the ambient concentrations of toxic substances. This is accomplished by using a screening air dispersion model and assuming conditions that result in maximum impacts. The applicant's screening analysis was performed using the CARB/OEHHA Hotspots Analysis and Reporting Program (HARP) modeling program with a modification described in Amended AFC Appendix 8.1-C, Section 1.2. Staff used the AERMOD/HARP model in its HRA. Finally, ambient concentrations were used in conjunction with RELs and cancer unit risk factors to estimate health effects which might occur from exposure to facility emissions. Exposure pathways, or ways in which people might come into contact with toxic substances, include inhalation, dermal (through the skin) absorption, soil ingestion, consumption of locally grown plant foods, and mother's milk.

The above method of assessing health effects is consistent with OEHHA's Air Toxics Hot Spots Program Risk Assessment Guidelines (OEHHA 2003) referred to earlier, and results in the following health risk estimates.

Impacts

The applicant's health risk assessment for the project, including combustion and non-combustion emissions, resulted in a maximum acute hazard index of 0.03 and a maximum chronic hazard index of 0.06. The locations of the maximum acute and chronic hazards are shown in Figure 8.1C-1 of the amended AFC. As **Public Health Table 3** shows, both acute and chronic hazard indices are under the level of significance of 1.0, indicating that no short- or long-term adverse health effects are expected.

PUBLIC HEALTH Table 3
Operations Risk and Hazard at Point of Maximum Impact (Applicant)

Type of Hazard/Risk	Hazard Index/Risk	Significance Level	Significant?
Acute Noncancer	0.03[a]	1.0	No
Chronic Noncancer	0.06	1.0	No
Individual Cancer	10.7 in 1 million	10 in 1 million	**Yes**
a. The Acute Noncancer HHI was not recalculated by the applicant from the previous HRA, but staff believes that Acute Noncancer HHI will not be above the significance level.			

Source: SR 20007i,

As shown in **Public Health Table 3**, total worst-case individual cancer risk was calculated by the applicant to be 10.7 in one million.

Staff conducted an independent analysis of cancer risks and acute and chronic hazards due to emissions from all ten of the reciprocating engines operating 100 hours/year (or a combination of engines operating 1000 hours/year) on diesel fuel.

Staff's quantitative analysis of facility operations included the following:

- Emissions from the 10 dual-fuel reciprocating engine generators, the emergency diesel generator, and the diesel fire pump engine were included in the analysis. Each of the 10 dual-fuel reciprocating engines was modeled as a separate stack, 100 feet in height.
- Exposure pathways assessed in the analysis include inhalation, dermal absorption, soil ingestion and mother's milk.

Air dispersion modeling was conducted by staff using AERMOD with five years of local meteorological data. (Please refer to the **Air Quality** section of this PSA under the heading *"Modeling Methodology for HBRP"* for a more detailed discussion of the modeling protocol.) The results are presented in **Public Health Table 4**.

Public Health Table 4
Air Dispersion Results (Chi/Q) Using AERMOD

Emission Source	Annual Chi/Q At the Point of Maximum Impact (PMI) (ug/m^3 per g/sec per facility)	Location of PMI
Internal combustion engines 10 split stacks Mode = 1G	0.67058	UTM E: 398,075 m UTM N: 4,508,575 m Elev: 89.94 m
Emergency generator	1.03922	At location shown above
Fire pump engine	0.37459	At location shown above

The emission factors used in staff's analysis of cancer risk and chronic hazard are listed in **Public Health Table 5**. Emission factors for natural gas and diesel emissions were based on 100 hours/year of liquid fuel (diesel) firing and are presented in Applicant's Table 8.1A-8A of the Sierra Research letter dated November 9, 2007. Annual facility emissions in units of tons/year are converted to units of g/sec/facility for this analysis. Emissions are given in units of pounds/year/engine for individual engines (see **Public Health Table 5**). These values are listed in units of pounds per year per engine and in units of pounds/year/facility (for all 10 engines). Emissions are then converted to units of g/sec/facility. Ground level concentrations (GLCs) at the Point of Maximum Impact (PMI) of substances emitted from the engines were determined by multiplying the g/sec/facility emission factor (the sum of emissions from all ten stacks) for each substance by the Chi/Q value at the PMI. The GLC for diesel from the emergency generator and the fire pump were determined in similar manner. The diesel GLC is the sum of the GLCs determined for the 10 engines, the emergency generator and the fire pump.

Public Health Table 5
Emission Factors and Ground Level Concentrations Used in the Cancer Risk and Chronic Hazard Analysis (1,000 hours/year of diesel fuel firing)

Based on 1000 hours/year Liquid Fuel Firing	Natural Gas plus Diesel		
	Facility Annual Emissions	Facility Annual Emissions	Ground Level Conc's At PMI
Substance	tons/yr (Table 8.1A-8A)	g/sec/facility (converted from tons/yr/facility)	ug/m^3 (g/sec x Chi/Q)
INTERNAL COMBUSION ENGINES			
1,3-Butadiene	9.92E-01	2.86E-02	1.92E-02
Acetaldehyde	1.43E+00	4.12E-02	2.76E-02
Acrolein	1.60E-01	4.59E-03	3.08E-03
Ammonia	6.34E+01	1.83E+00	1.22E+00
Anthracene	3.22E-04	9.26E-06	6.21E-06

Benzene	5.89E-01	1.70E-02	1.14E-02
Benzo(a)anthracene	1.59E-04	4.58E-06	3.07E-06
Benzo(a)pyrene	7.30E-06	2.10E-07	1.41E-07
Benzo(b)fluoranthene	1.11E-04	3.18E-06	2.13E-06
Benzo(k)fluoranthene	2.12E-05	6.10E-07	4.09E-07
Chrysene	3.87E-05	1.11E-06	7.46E-07
Dibenz(a,h)anthracene	7.30E-06	2.10E-07	1.41E-07
Diesel PM[1]	2.78E+00	8.00E-02	5.39E-02
Ethylbenzene	1.92E-01	5.53E-03	3.71E-03
Formaldehyde	1.06E+01	3.06E-01	2.05E-01
Hexane	3.06E+00	8.80E-02	5.90E-02
Indeno(1,2,3-cd)pyrene	1.94E-05	5.58E-07	3.74E-07
Naphthalene	6.79E-02	1.95E-03	1.31E-03
Propylene	1.45E+01	4.19E-01	2.81E-01
Toluene	6.46E-01	1.86E-02	1.25E-02
Xylene (Total)	1.75E+00	5.03E-02	3.37E-02
DIESEL ENGINES			
Diesel PM from Emergency generator	6.2E-03	1.79E-04	1.86E-04
Diesel PM from Fire pump	1.6E-03	4.61E-05	1.73E-05

GLCs were then entered into the HARP program according to the protocol outlined in Topic 8 of the HARP How-to Guide ("*How to Perform Health Analyses Using a Ground Level Concentration*"). Cancer risk and chronic hazard index were determined under the Derived (OEHHA) and Average Point risk assessment methods. Results of staff's analysis are summarized in **Public Health Table 6** and are compared to the results presented in the applicant's November 9, 2007 letter. Substance-specific risks are presented in **Public Health Table 7**. All cancer risks are calculated under the 70 year residential exposure scenario.

Public Health Table 6
Results of Staff's Analysis and the Applicant's Analysis for Cancer Risk and Chronic Hazard

	Staff's Analysis AERMOD dispersion modeling and HARP risk analysis		Applicant's Analysis	
Conditions/ Receptor	Cancer Risk (per million)	Chronic HI	Cancer Risk (per million)	Chronic HI
1000 hrs/yr diesel PMI	29.1	0.14	10.7	0.06

[1] Total GLC for Diesel PM at the PMI is equivalent to 5.37E-02 ug/m^3 from the internal combustion engines plus 1.86E-04 ug/m^3 from the emergency diesel generator plus 1.73E-05 ug/m^3 from the diesel fire pump, or 5.39E-02 ug/m^3.

Discussion

Staff has analyzed potential public health risks associated with construction and operation of HBRP. Given the information staff has available on the emission factors for the toxic air contaminants that would be emitted from the ten Wärtsilä engines when burning diesel fuel, staff concludes that the risk of cancer would be above the level of significance (10 excess cancers in one million). Staff also concludes that no acute (short-term) or chronic (long-term) non-cancer health impacts would be expected to occur to any members of the public including low income and minority populations.

Although staff uses a health-protective methodology that accounts for impacts to the most sensitive individuals in a given population, including newborns and infants, staff believes that the lack of accurate emission factors for the Wärtsilä engines when using diesel fuel contributes greatly to the uncertainty of its health risk assessment. However, at the same time that staff acknowledges this uncertainty, staff must also point out that it has asked both the applicant and Wärtsilä for more accurate emission factors since January 2007. The failure to provide more accurate emission factors of toxic air contaminants when using diesel fuel, especially the emissions of diesel particulates which "drive" the risk assessment when using this fuel, gave staff little choice but to use the same emission factors from surrogate engines found in the CATEF data base that the applicant uses in its risk assessment.

There are options that the applicant can pursue to reduce the uncertainty associated with the emission factors such as conducting source tests of the engines to be used prior to the issuance of the FSA so that staff may have the necessary data to revise its health risk assessment.

Public Health Table 7
Results of Staff's Analysis: Contribution to Total Cancer Risk by Individual Substances

Risk per million	1000 hrs/yr diesel	
	Derived (OEHHA) Method	Average Point Estimate
Natural Gas Components		
Formaldehyde	1.6	1.1
Benzo(a)pyrene	0.0056	0.0014
Dibenz(a,h)anthracene	0.0020	0.00049
Benzo(a)anthracene	0.012	0.0025
Benzene	0.43	0.30
Acetaldehyde	0.10	0.072
Naphthalene	0.059	0.041
Indeno(1,2,3-cd)pyrene	0.0015	0.00030
Benzo(b)fluoranthene	0.0085	0.0017
Benzo(k)fluoranthene	0.0016	0.00033
Chrysene	0.00030	0.000060
1,3-Butadiene	4.3	3.0

Risk due to Natural Gas from Wärtsilä Engines	6.6	4.5
Risk due to Diesel Particulate Matter from Wärtsilä Engines	22.4	15.4
Risk due to Diesel Particulate Matter from Emergency Generator	0.11	0.076
Risk due to Diesel Particulate Matter from Fire Pump	0.010	0.0071
Total Risk (all sources)	29.1	20.0

There are options that the applicant can pursue to reduce the risk to the public to below the level of significance. The applicant can:

1. Reduce hours of 100-percent diesel firing;

2. Reduce diesel particulate emissions from the stacks with post-combustion controls such as diesel particulate filters or catalysts;

3. Use alternative fuels such as compressed natural gas stored on-site, or compressed or liquefied natural gas or propane stored at another location; or

4. Use alternative technologies such as combustion turbines that could change flue gas parameters to reduce modeled impacts.

Additionally, the applicant could conduct a health risk assessment of the emissions from the existing power plant so as to establish a baseline of risk and thus be able to demonstrate that the new project will result in the reduction of existing risk as stated by the applicant but not documented. Staff is aware of the applicant's statements that a dual fuel power plant is required at this location in the state due to the historical frequency of natural gas curtailments. Staff is also aware that power blackouts should be avoided and believes that the impacts to public health posed by a power blackout should be considered in the licensing process. Indirect impacts on public safety and/or health from the loss of electricity have been demonstrated during power shortages. These impacts of power outages include:

- Loss of traffic signals,
- Threat of increased crime,
- Inadequate operation of air traffic control towers,

- Inadequate emergency care due to 911 operators not being able to receive messages,
- Inadequate surgery and emergency care at hospitals due to limited energy supply,
- Loss of critical home medical devices such as home dialysis units,
- Loss of power to elevators, computer systems, heating, lighting, and air conditioning, and
- Economic disruption resulting in loss of jobs thus causing loss of individual/family health insurance.

Increased car accidents during blackouts due to loss of traffic lights are also of concern. Experience with power blackouts in Europe shows, for example, that traffic accidents occurred across Italy as drivers raced towards junctions without traffic lights during the September 2003 blackout. While the Energy Commission indicated in May 2002 that mitigation of loss of power and increased accidents rates due to disabled traffic lights is possible by using battery backup during power outages, cities without such backups must rely on a constant power supply to prevent an increase in accidents. During blackouts, hospitals use backup generators that can supply only a limited amount of electricity. Therefore, hospitals only operate the most crucial equipment which limits surgery and emergency services. Additionally, small clinics may lack power backup all together (SF Chronicle 2001). Indirect impacts on the chronically ill from loss of electricity to home treatment machines (dialysis, other medical devices) can also occur. Persons that rely on home medical devises such as dialysis machines, oxygen generators, or breathing aids, are especially vulnerable to the impacts of power outages. According to an article posted in the San Francisco Chronicle in January 2001, patients on such devices that do not have adequate backup power supplies are at risk (SF Chronicle 2001). Economic disruptions can also result from sporadic, periodic, or even occasional power shortages. For example, New York City officials estimated a loss of about 1.1 billion dollars resulting from the August 2003 blackout. The losses were due mainly to interruption of productivity and manufacturing and loss of spoiled food from restaurants and supermarkets (Teather 2003). Other examples of economic losses due to power outages have been seen in the tech industry in Silicon Valley, which loses millions of dollars per minute when power is out (Konrad 2000). The loss of jobs resulting from such economic disruption can indirectly impact health by reducing wages and/or insurance coverage. These direct and indirect impacts on public health from a power blackout are real and staff believes should be considered in the licensing process. However, while staff is aware that diesel has been used extensively in the past to avoid power blackouts during periods of natural gas curtailment, staff believes that there are other options to consider which pose fewer public health impacts and believes that alternatives to the applicant’s proposed use of diesel fuel warrant greater exploration.

CUMULATIVE IMPACTS AND MITIGATION

The maximum cancer risk for emissions from the HBRP (calculated by staff) is 29.1 in one million at a location east of the facility boundary. The maximum impact location occurs where pollutant concentrations from the HBRP would theoretically be the highest. At this location, emissions when diesel fuel is used would cause a significant change in lifetime risk to the public. Modeled facility-related residential risks would be lower at more distant locations but would also be above the level of significance at many of these locations. Since the project incrementally poses a significant risk to public health, staff also concludes that its contribution to a cumulative public health risk is also significant.

The worst-case long-term (chronic) and short-term (acute) noncancer health impacts from HBRP as calculated by staff (0.14 and 0.11, respectively) are below the significance level of 1.0 at the location of maximum impact. At this level, staff does not expect any incremental or cumulative health impacts to be the result of emissions from the proposed power plant. Long-term hazard would also be lower at all other locations.

The regional cumulative air quality impacts analysis presented in the **Air Quality** section of this PSA demonstrates that the cumulative impacts of the project would be no different than the impacts of the project itself.

COMPLIANCE WITH LORS

Staff concludes that construction and operation of the HBRP would not be in compliance with all applicable LORS regarding long-term and short-term project impacts in the area of Public Health. The use of diesel fuel would result in a significant risk and would thus be in violation of California Health and Safety Code section 41700 and Health and Safety Code Sections 44360 to 4366 (Air Toxics “Hot Spots” Information and Assessment Act—AB 2588). Additionally, the project owner would be required to issue warnings to the surrounding community pursuant to Proposition 65 (Health and Safety Code 25249.5 et seq.) and would be in violation of that statute if warnings were not provided.

CONCLUSIONS

Staff has analyzed potential public health risks associated with construction and operation of HBRP. Given the information provided by the project applicant on the emission factors for the toxic air contaminants that would be emitted from the ten Wärtsilä engines when burning diesel fuel and using EPA-approved modeling, staff has found that the risk of cancer would be 29.1 in a million. This is considerably above the level of significance (10 excess cancers in one million with the use of Toxics-Best Available Control Technology -- T-BACT) used in all power plant siting cases. In the numerous other in-state power plant proposals reviewed by staff, staff has not seen cancer risks above this level of significance. The applicant has also estimated the cancer risk would be above the level of significance considering the same scenario as analyzed by staff. Staff also concludes that no acute (short-term) or chronic (long-term) non-cancer health impacts would be expected to occur to any members of the public including low income and minority populations.

Staff believes that there are several options that the applicant should pursue to reduce the risk to the public to below the level of significance. They are:

1. Reduce diesel particulate emissions from the stacks with post-combustion controls such as diesel particulate filters or catalysts;

2. Use alternative fuels such as compressed natural gas stored on-site, or compressed or liquefied natural gas or propane stored at another location; or

3. Use alternative technologies such as combustion turbines that could change flue gas parameters to reduce modeled impacts.

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